



Designing AI for Competitive Games

Bruce Hayles & Derek Neal



Introduction



Meet the Speakers

Derek Neal



Director of Production

Bruce Hayles

@brucehayles



Software Engineer



The Problem



Same Old Song



New User



Plays Single Player



Learns to beat the AI



Goes Online



Gets Destroyed



Gets Frustrated

Quits the Game, Never to Return.

Could the AI help?

- AI “bots” in competitive games often...
 - ...don't play by the same rules humans do
 - ...teach new players bad behaviors
 - ...unintentionally steepen the learning curve
 - ...make it harder to transition to online play
 - ...aren't useful for experienced players to train against

Challenges

- Traditional AI techniques aren't very good at replicating human behavior
 - AI fighters don't have the same limitations player do
 - AI fighters don't make decisions the same way players do
 - AI fighters don't strategize or socialize the way players do
- As the game evolves over time, player strategies tend to change
 - As a result, even something that was a great AI at the time the game shipped might become “bad” over time

Our Solution

- The **Shadow System**
 - Copies player behaviors in order to create an unlimited number of unique AI fighters.
- Shadow fighters...
 - ...aren't super human
 - ...are easy to train
 - ...learn strategies, tactics, and social behaviors dynamically
 - ...evolve over time as players get better

Reception



Community Response

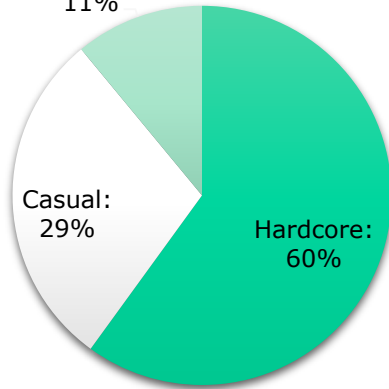
(<https://youtu.be/4gdHArtnVE8>)

Survey Responses

- **79%** of players report having used the mode
 - **48%** of players report using the mode regularly
 - **46%** of players report playing online
-
- Responses from the survey were extremely positive, with additional support for the mode and adding new features being the main requests.

Survey Demographics

Very Casual:
11%



Casual:
29%

Hardcore:
60%

Live Demo

(<https://youtu.be/WTIIowbaKks>)

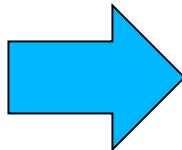
Quick System Overview

Record Everything

World States



Actions

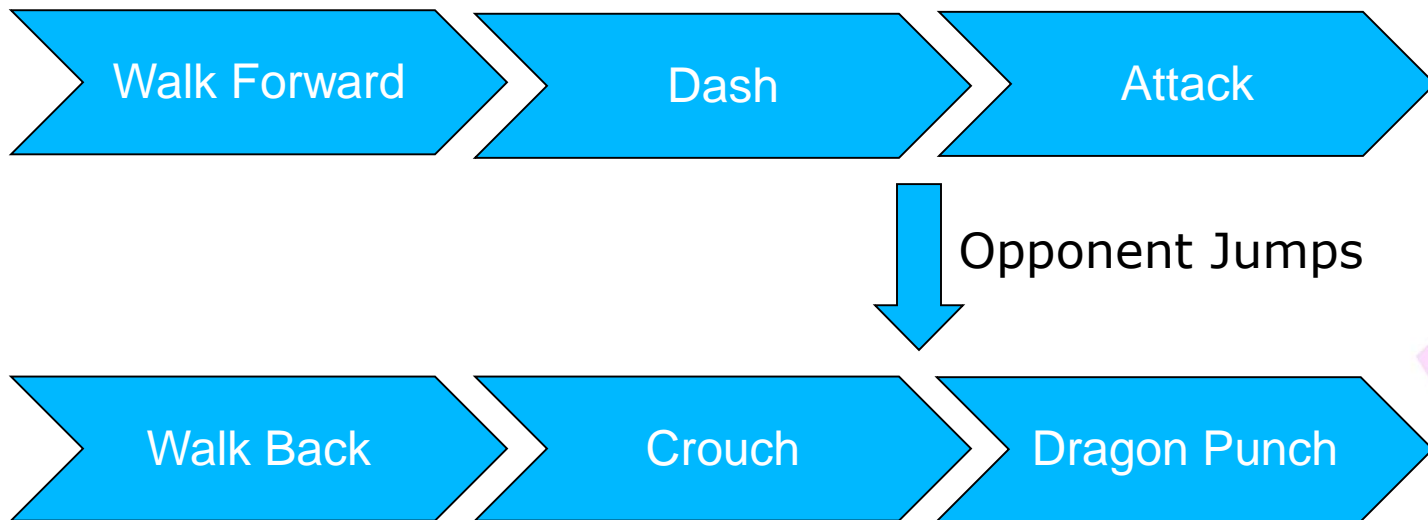


Find and Play Back Actions



Sequential Actions

- Once an action is selected, the AI will continue playing back sequential actions until a major deviation is encountered.



Sequential Actions Video

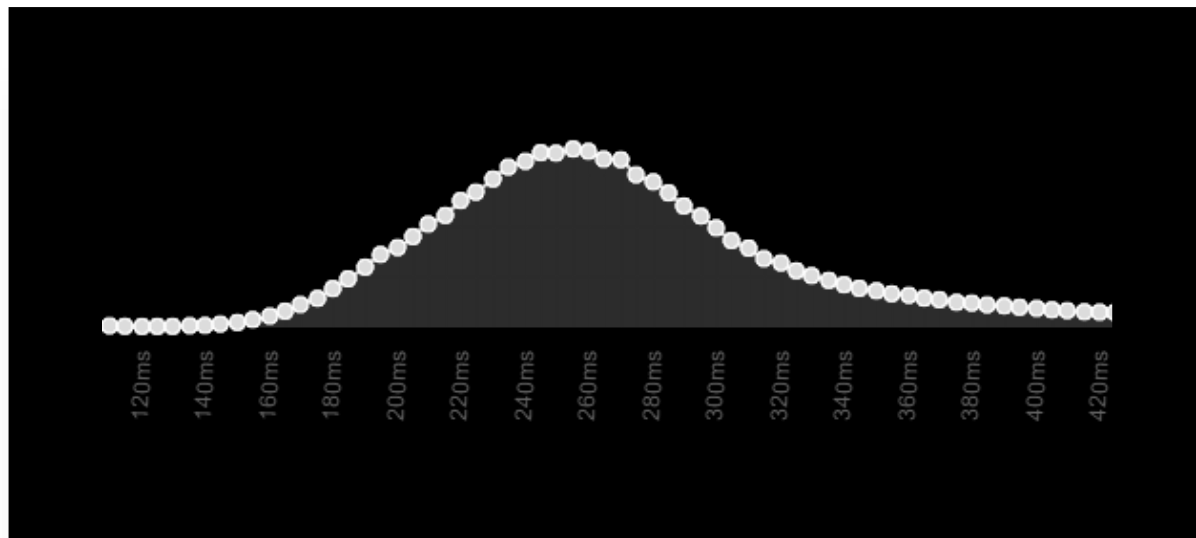
(https://youtu.be/J6_WnY49HRO)

Human Limitations



Reaction Time

- Majority of people have reaction times between 200 and 320ms (between 12 and 19 frames at 60 FPS)
- Most actions in Killer Instinct hit in less than 12 frames, and thus are not reactable.
- Players must choose actions to maximize risk/reward based on history of enemy's actions



Reactable



Not Reactable



Our Solution

- Capture and playback everything that the player did – including the reactions that the player made.
- For example, if a player takes 200ms to react to a fireball, the playback includes 200ms of the player standing around, causing the shadow to mimic this delay.
- A system that fails to capture this “guessing” behavior will not be playing the same game the players are.

Aim Bot Video

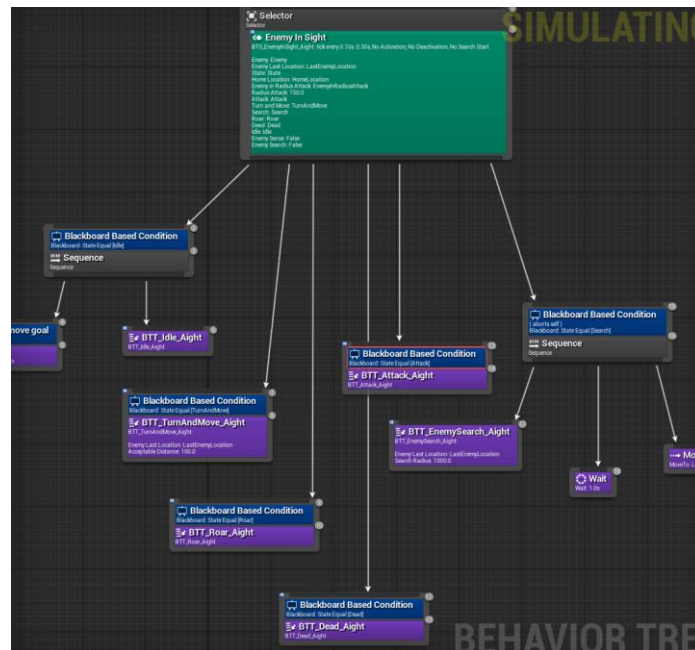
(<https://youtu.be/0aTmcG1Dvc0>)

Human Decision Making



Traditional Approach

- Developer explicitly models specific sets of behaviors
 - Attack when the opponent is close
 - Block when they attack you
- Fidelity and amount of behaviors that can be made are limited by developer resources



The Shadow System

- Replicates virtually all types of behaviors by:
 1. Selecting actions based on how similar the recorded situation is to the current situation; and
 2. Continuing to play back the actions that follow the selected action unless a large divergence occurs.
- To determine how similar the two situations are, the Shadow System uses **Similarity Functions**, **Weights**, and **Heuristics**.

Similarity (Health and Distance)

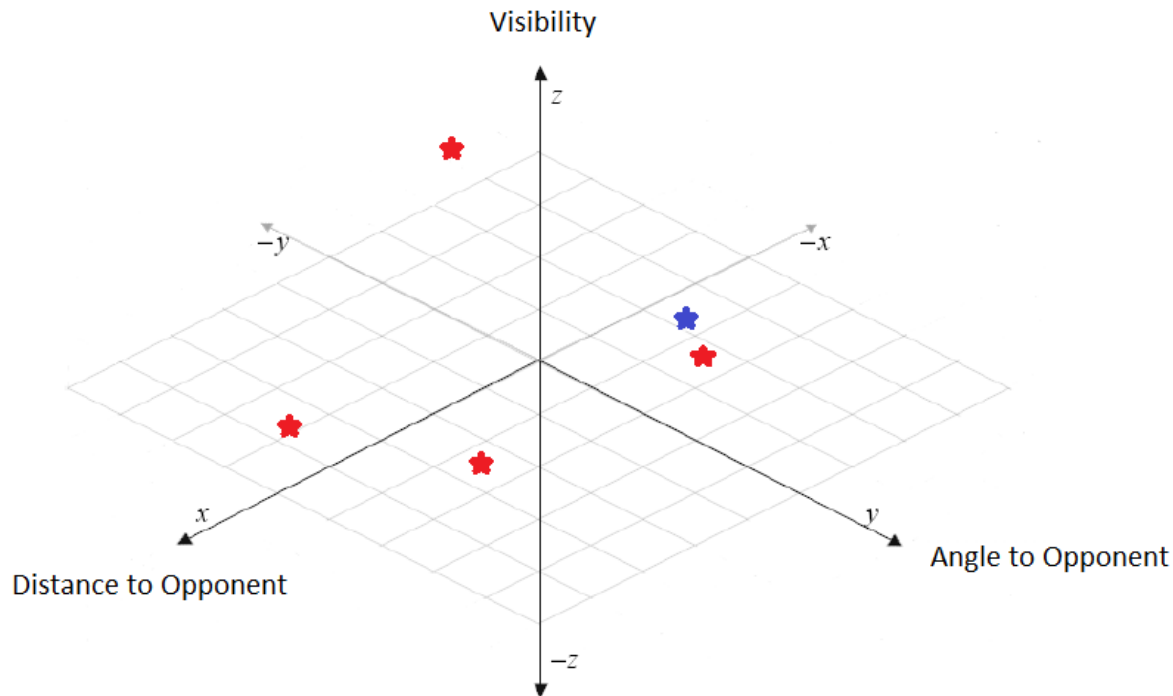


Creating a Score

{ Difference in Health }	x	{ Weight }	=	Health Score
{ Difference in Distance }	x	{ Weight }	=	Distance Score
{ Difference in Timer }	x	{ Weight }	=	Time Score
{ Difference in Meter }	x	{ Weight }	=	Meter Score
{ Difference in Ammo }	x	{ Weight }	=	Ammo Score
...				

Add up all the Scores to make a total.
The action with the lowest total is the best match.

Target Selection in Counter Strike



Heuristics

- Players often keep track of information that the game does not, and use that information to change their behavior.
 - For example, players might notice how often an opponent attacks high vs. low, and then change how they're blocking to match
- Deliberately adding tracking for these trends allows the Shadows to adjust their behavior the same way the player does.
 - Note if a player does not change their behavior in these situations, neither will their Shadow

Human Strategy



High Level Behaviors

- The Shadow system dynamically captures many types of strategic and tactical behaviors, without explicit knowledge of any of them:
 - Rushdown
 - Footsies
 - Zoning
 - Mixups
 - Setting traps
- Also captures social behaviors, like taunts



Tournament Player Shadow

(<https://youtu.be/Mto-aIJC5q8>)



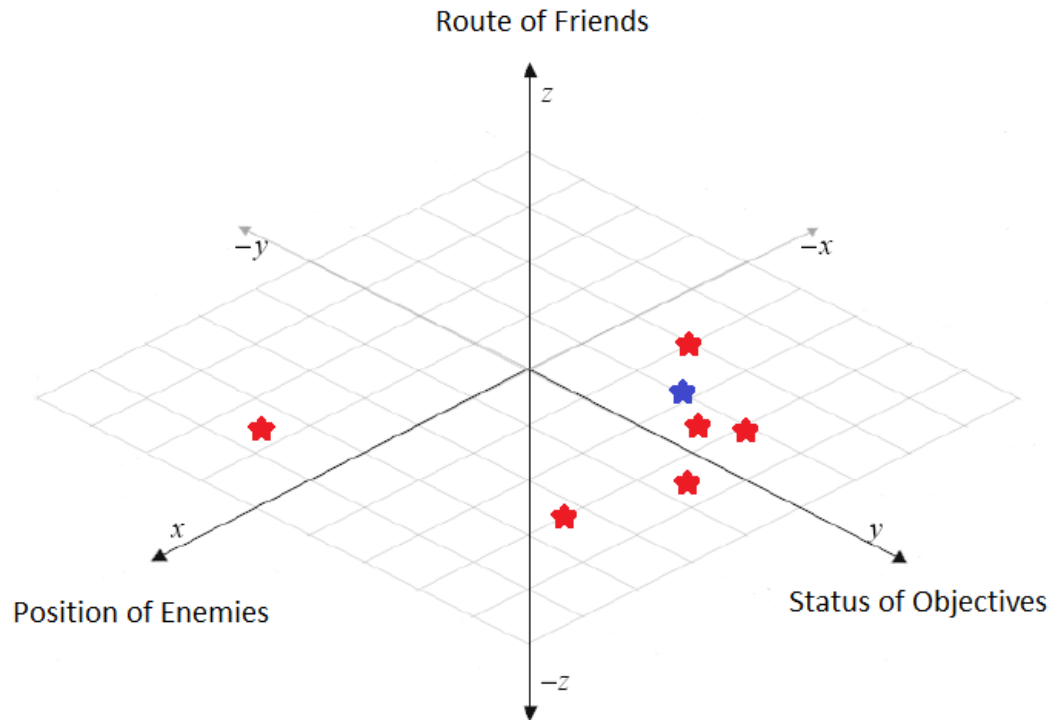
Player Taunted By His Shadow

(<https://youtu.be/f7xbc0ETVMA>)

Bot Coordination

(<https://youtu.be/b3nZdPKT10w>)

Coordination in Counter Strike



The Metagame

- As players learn more about the game, the strategies and tactics they employ can change
 - New setups
 - New combos
 - New bugs / exploits
 - Balance changes
- By continuously copying player behaviors, Shadows can keep up with the player base as the Metagame shifts

Conclusion



Summary

- AI in competitive games often does new players a disservice, but this is a solvable problem
- The approach we used to build the Shadow system...
 - ...can work for any competitive game
 - ...can potentially save time time and money
 - ...can have benefits outside of gameplay
 - Such as easier / quicker content generation



Future Ideas

- **Training** – Play against Shadows of stronger players / teams in order to improve your game
- **Tutorials** – Shadows with specific behaviors can teach important lessons (e.g., dealing with fireballs)
- **Difficulty Ramp** – Shadows of varying difficulty levels can gradually ramp up the difficulty level of the game

Future Ideas, Cont.

- **Self Reflection** – Play against yourself in order to identify your weaknesses
- **Filling gaps** – When not enough players are available in the matchmaking pool, Shadows can fill the vacant spots
- **Drop In / Drop Out** – Players can take over for their Shadow at any point, or drop out and leave a shadow

Future Ideas, Cont.

- **Remixing Shadows** – Combine data from multiple players to create new opponents
- **AI Tournaments** – Tournaments populated entirely by AI fighters



Special Thanks



Q&A

